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under 37 CFR 1.53(b))

Title of Invention

METHOD AND SYSTEM FOR IDENTIFYING, FIXING, AND  
UPDATING SECURITY VULNERABILITIES

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## APPLICATION ELEMENTS

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## ACCOMPANYING APPLICATION PARTS

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[Note Box 5 Below]
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Signed statement attached deleting  
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## METHOD AND SYSTEM FOR IDENTIFYING, FIXING, AND UPDATING SECURITY VULNERABILITIES

### 5 Technical Field

This invention relates to network communications for computers, and more particularly, to operating system security over open networks.

### Background of the Invention

10 As Internet technology has advanced, users are able to access information on many different operating systems. Hackers take advantage of the open network architecture of the Internet, and attempt to gain access to operating systems without authorization. Hackers present a significant security risk to information stored on a operating system. In an effort to limit unauthorized access to operating system  
15 resources, many operating system communication security devices and techniques have been developed.

One security device and technique that has been used to secure operating system resources is an Internet scanner. A scanner enables a user to find and report security vulnerabilities in network-enabled operating systems. The scanner can run a  
20 list of checks, or exploits, that verify the presence or absence of known security vulnerabilities. The exploits' findings are displayed to the user, and reports may be generated showing the discovered security vulnerabilities and methods for fixing them.

Although scanners are very useful, they lack services that users need to  
25 adequately protect their operating systems. The release cycle of a scanner is long compared to the time required to develop and test individual security checks. New security vulnerabilities are introduced very rapidly, and must be found and addressed in real-time. Because hackers create problems in systems on a minute-to-minute basis, a scanner must be updated constantly to be most valuable to a user.

30 What is needed is a method and system for providing updated exploit information in a short time period. A scanner needs to have its components sufficiently separated so that individual information used in the scanner can be updated independently. A scanner's individual security exploits need to be updated and released independently of the entire scanner's release cycle. The exploit  
35 information needs to be available on an per-exploit basis so that minor, but important,

modifications can be made without affecting the entire system. In addition, exploit information, including help information, needs to be updated independently of the exploit itself.

5 A further need in the art exists for a user-friendly scanner with the above update capability. The user needs to be able to use the system without needing to know whether the exploits are included in the scanner or are separately installed via update procedures.

10 A further need in the art exists for a scanner with the above update capability that includes mutual authentication procedures. Constant update packages necessitate ensuring that the scanner will only load legitimate updates, and that updates will only be loaded into legitimate scanners.

### **Summary of the Invention**

15 The present invention satisfies the above-described needs by providing a system and method for identifying, fixing, and updating security vulnerabilities in host computers. In an exemplary embodiment, the identifying, fixing, and updating capabilities can be done by communication between a scanner with plug-in capability, an operating system, and an express update package.

20 The express update package can contain exploit plug-in modules, resource plug-in modules, dat files, and help files. The exploit plug-in modules and the resource plug-in modules can be dynamic-link libraries (DLLs). The exploit plug-in module can contain exploit objects and the resource plug-in module can contain resource objects. The exploit objects can contain exploits and the resource objects can contain resources. An exploit can be an individual security check that is done on  
25 a computer or systems. A resource can be an individual resource that is used by the scanner, and can include data, executable code, or a network connection.

The present invention can yield an architectural solution that allows the exploits within the scanner, and the exploits in the express update package, to function with no knowledge of each other. Because the exploit objects and the  
30 resource objects can hide their implementation details behind standard interfaces, they may be managed and manipulated by the scanner without knowledge of their internal make-up. This architectural solution can allow existing exploits to be modified and incorporated into the scanner without updating the entire scanner. In addition, new exploits may be added to the scanner without updating the entire scanner. The  
35 present invention can be user-friendly in that the user needs no knowledge regarding

whether the exploits are included in the scanner's installation package or are separately installed via update procedures.

The present invention can also include mutual authentication procedures. The authentication procedures can enable the scanner to load only legitimate plug-in  
 5 modules, and can provide that plug-in modules can only be loaded into legitimate scanners.

### **Brief Description of the Drawings**

FIG. 1 is a block diagram of a personal computer that provides an exemplary  
 10 operating environment for an exemplary embodiment of the present invention.

FIG. 2 is a block diagram illustrating internal program objects of an exemplary embodiment which can report actions between an operating system, a scanner with plug-in capability, and an express update package.

FIG. 3 is a screen display of information the user can access in an Inventory  
 15 folder in an exemplary embodiment of the present invention.

FIG. 4 is a screen display of information the user can access in a Vulnerabilities folder in an exemplary embodiment of the present invention.

FIG. 5 is a screen display of information the user can access in a Services folder in an exemplary embodiment of the present invention.

FIG. 6 is a screen display of information the user can access in a Accounts  
 20 folder in an exemplary embodiment of the present invention.

FIG. 7 is a screen display showing the different views the user can access in an exemplary embodiment of the present invention.

FIG. 8 is a flowchart diagram illustrating an exemplary method for  
 25 identifying, fixing, and updating security vulnerabilities in a host computer or computers.

FIG. 9 is a flowchart diagram illustrating an exemplary method for initializing a scanner.

FIG. 10 is a flowchart diagram illustrating an exemplary method for running  
 30 load security and loading a plug-in module.

FIG. 11 is a flowchart diagram illustrating an exemplary method for initializing a policy manager.

FIG. 12 is a flowchart diagram illustrating an exemplary method for running activation security and creating available exploit/ resource objects.

FIG. 13 is a flowchart diagram illustrating an exemplary method for getting license, policy and host information.

FIG. 14 is a flowchart diagram illustrating an exemplary method for getting policy information.

5        FIG. 15 is a flowchart diagram illustrating an exemplary method for running exploits.

FIG. 16 is a flowchart diagram illustrating an exemplary method for running built-in exploits.

10       FIG. 17 is a flowchart diagram illustrating an exemplary method for running plug-in exploits.

FIG. 18 is a flowchart diagram illustrating an exemplary method for determining an optimal order for running plug-in exploits.

### **Detailed Description of Exemplary Embodiments**

15        The present invention can be a method of identifying, fixing, and updating security vulnerabilities in a host computer or computers. In an exemplary embodiment, the identifying, fixing, and updating capabilities can be done by communication between a scanner with plug-in capability, an operating system, and a plug-in module. Because the exploit objects and the resource objects can hide their  
20       implementation details behind standard interfaces, they may be managed and manipulated by the scanner without knowledge of their internal make-up. This architectural solution can allow existing exploits to be modified and incorporated into the scanner without updating the entire scanner. In addition, new exploits may be added to the scanner without updating the entire scanner. Mutual authentication  
25       procedures can also be used to ensure that only legitimate scanners and express update package contents are used.

FIG. 1 is a block diagram of a personal computer that provides an exemplary operating environment. FIG. 2 is a block diagram illustrating internal program objects. FIGS. 3 - 7 are screen displays showing the user interface (UI) component  
30       for an exemplary embodiment of the present invention. FIGS. 8 - 18 are flowchart diagrams illustrating exemplary methods for identifying, fixing, and updating security vulnerabilities in a host computer or computers.

Although the preferred embodiment will be generally described in the context of a program and an operating system running on a personal computer, those skilled  
35       in the art will recognize that the present invention also can be implemented in

conjunction with other program modules for other types of computers. Furthermore, those skilled in the art will recognize that the present invention may be implemented in a stand-alone or in a distributed computing environment. In a distributed computing environment, program modules may be physically located in different local and remote memory storage devices. Execution of the program modules may occur locally in a stand-alone manner or remotely in a client/server manner. Examples of such distributed computing environments include local area networks of an office, enterprise-wide computer networks, and the global Internet.

The detailed description which follows is represented largely in terms of processes and symbolic representations of operations by conventional computer components, including a central processing unit (CPU), memory storage devices for the CPU, display devices, and input devices. Furthermore, these processes and operations may utilize conventional computer components in a heterogeneous distributed computing environment, including remote file servers, remote compute servers, and remote memory storage devices. Each of these conventional distributed computing components is accessible by the CPU via a communications network.

The processes and operations performed by the computer include the manipulation of signals by a CPU or remote server and the maintenance of these signals within data structures resident in one or more of the local or remote memory storage devices. Such data structures impose a physical organization upon the collection of data stored within a memory storage device and represent specific electrical or magnetic elements. These symbolic representations are the means used by those skilled in the art of computer programming and computer construction to most effectively convey teachings and discoveries to others skilled in the art.

For the purposes of this discussion, a process is generally conceived to be a sequence of computer-executed steps leading to a desired result. These steps generally require physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of electrical, magnetic, or optical signals capable of being stored, transferred, combined, compared, or otherwise manipulated. It is conventional for those skilled in the art to refer to these signals as bits, bytes, words, data, objects, properties, flags, types, identifiers, values, elements, symbols, characters, terms, numbers, points, records, images, files or the like. It should be kept in mind, however, that these and similar terms should be associated with appropriate physical quantities for computer operations, and that these terms are merely

conventional labels applied to physical quantities that exist within and during operation of the computer.

It should also be understood that manipulations within the computer are often referred to in terms such as comparing, selecting, viewing, getting, giving, etc. which are often associated with manual operations performed by a human operator. The operations described herein are machine operations performed in conjunction with various input provided by a human operator or user that interacts with the computer.

In addition, it should be understood that the programs, processes, methods, etc. described herein are not related or limited to any particular computer or apparatus, nor are they related or limited to any particular communication network architecture. Rather, various types of general purpose machines may be used with program modules constructed in accordance with the teachings described herein. Similarly, it may prove advantageous to construct a specialized apparatus to perform the method steps described herein by way of dedicated computer systems in a specific network architecture with hardwired logic or programs stored in nonvolatile memory, such as read only memory.

Referring now to the drawings, in which like numerals represent like elements throughout the several figures, aspects of the present invention and the preferred operating environment will be described.

### **The Operating Environment**

FIG. 1 illustrates various aspects of an exemplary computing environment in which the present invention is designed to operate. Those skilled in the art will immediately appreciate that FIG. 1 and the associated discussion are intended to provide a brief, general description of the preferred computer hardware and program modules, and that additional information is readily available in the appropriate programming manuals, user's guides, and similar publications.

### **The Computer Hardware**

FIG. 1 illustrates a conventional personal computer 10 suitable for supporting the operation of the preferred embodiment of the present invention. As shown in FIG. 1, the personal computer 10 operates in a networked environment with logical connections to a remote computer 11. The logical connections between the personal computer 10 and the remote computer 11 are represented by a local area network 12 and a wide area network 13. Those of ordinary skill in the art will recognize that in

this client/server configuration, the remote computer 11 may function as a file server or computer server.

The personal computer 10 includes a CPU 14. The personal computer also includes system memory 15 (including read only memory (ROM) 16 and random access memory (RAM) 17), which is connected to the CPU 14 by a system bus 18. The preferred computer 10 utilizes a BIOS 19, which is stored in ROM 16. Those skilled in the art will recognize that the BIOS 19 is a set of basic routines that helps to transfer information between elements within the personal computer 10. Those skilled in the art will also appreciate that the present invention may be implemented on computers having other architectures, such as computers that do not use a BIOS, and those that utilize other microprocessors, such as the "MIPS" or "POWER PC" families of microprocessors from Silicon Graphics and Motorola, respectively.

Within the personal computer 10, a local hard disk drive 20 is connected to the system bus 18 via a hard disk drive interface 21. A floppy disk drive 22, which is used to read or write a floppy disk 23, is connected to the system bus 18 via a floppy disk drive interface 24. A CD-ROM or DVD drive 25, which is used to read a CD-ROM or DVD disk 26, is connected to the system bus 18 via a CD-ROM or DVD interface 27. A user enters commands and information into the personal computer 10 by using input devices, such as a keyboard 28 and/or pointing device, such as a mouse 29, which are connected to the system bus 18 via a serial port interface 30. Other types of pointing devices (not shown in FIG. 1) include track pads, track balls, pens, head trackers, data gloves and other devices suitable for positioning a cursor on a computer monitor 31. The monitor 31 or other kind of display device is connected to the system bus 18 via a video adapter 32.

The remote computer 11 in this networked environment is connected to a remote memory storage device 33. This remote memory storage device 33 is typically a large capacity device such as a hard disk drive, CD-ROM or DVD drive, magneto-optical drive or the like. The personal computer 10 is connected to the remote computer 11 by a network interface 34, which is used to communicate over the local area network 12.

As shown in FIG. 1, the personal computer 10 is also connected to the remote computer 11 by a modem 35, which is used to communicate over the wide area network 13, such as the Internet. The modem 35 is connected to the system bus 18 via the serial port interface 30. The modem 35 also can be connected to the public switched telephone network (PSTN) or community antenna television (CATV)



network. Although illustrated in FIG. 1 as external to the personal computer 10, those of ordinary skill in the art will quickly recognize that the modem 35 may also be internal to the personal computer 11, thus communicating directly via the system bus 18. It is important to note that connection to the remote computer 11 via both the local area network 12 and the wide area network 13 is not required, but merely illustrates alternative methods of providing a communication path between the personal computer 10 and the remote computer 11.

Although other internal components of the personal computer 10 are not shown, those of ordinary skill in the art will appreciate that such components and the interconnection between them are well known. Accordingly, additional details concerning the internal construction of the personal computer 10 need not be disclosed in connection with the present invention.

Those skilled in the art will understand that program modules such as an operating system 36 and data are provided to the personal computer 10 via computer-readable media. In the preferred computer, the computer-readable media include the local or remote memory storage devices, which may include the local hard disk drive 20, floppy disk 23, CD-ROM or DVD 26, RAM 17, ROM 16, and the remote memory storage device 33. In the preferred personal computer 10, the local hard disk drive 20 is used to store data and programs, including the operating system 36 and the scanner 37.

The focus of the express update package 38 is described below in a manner that relates to its use in a scanner 37 with plug-in capability of FIG. 1. This description is intended in all respects to be illustrative rather than restrictive. Alternative embodiments will be apparent to those skilled in the art.

### **The Internal Objects**

FIG. 2 is a block diagram illustrating internal program objects of an exemplary embodiment which can report actions between an operating system 36, a scanner 37 with plug-in capability, and an express update package 38. The scanner 37 can include a UI 205, a session manager 235, a thread manager 260, host-scanning threads 265, an engine 270, an exploit manager 230, and a resource manager 220. The present invention also can access a registry 285, a database 290, and some scanner log files 295.

An express update package 38 can contain exploit plug-in modules 299, resource plug-in modules 297, dat files 293, and help files 292. The exploit plug-in

modules **299** and the resource plug-in modules **297** can be DLLs. An exploit plug-in module **299** can contain one or more exploit objects **294**. An exploit object **294** can be a container for a plug-in exploit **291**. The plug-in exploit **291** can be an individual exploit, or security check, that is done on the host computer or computers.

5       The resource plug-in module **297** can contain one or more resource objects **298**. A resource object **298** can contain a plug-in resource **289**. The plug-in resource **289** can be an individual resource that is used by the scanner **37**. The resources may include data, executable code, or a network connection. Examples of resources are a list of known accounts on a host or an open file transfer protocol (FTP) connection.

10      Because the plug-in exploits **291** that produce and consume shared resources can be added to the scanner **37** installation dynamically, the resources can also have plug-in capability, and can be packaged and delivered separately from the scanner **37**. Like the exploit objects **294**, the resource objects **298** can expose standard interfaces enabling the scanner **37** to manage them without any knowledge of their function or

15      purpose.

      There can be several basic types of resources. A mandatory resource can be one that an exploit must have in order to perform successfully. An optional resource can be one that an exploit can use if the resource exists, but is not necessary for the exploit to function properly. A create-on-demand (C-O-D) resource can be a resource

20      that is created the first time it is requested. Afterwards, when a requested C-O-D resource already exists, the requestor will get the C-O-D resource, instead of having the resource recreated. A create-unique resource can be a resource that is always created afresh when requested, so that the requestor is guaranteed that the resource is unique and will not be accessed or used by any other requestor.

25      When a resource is created, it can be assigned a namespace based on its scope. The scope of a resource can be an indication of its specificity, and can include host-specific resources, session-specific resources, and global resources. A host-specific resource can only be used by exploits running against the host and in the session to which a resource belongs. A session-specific resource can be used only by exploits

30      running against a host in the scan session to which the resource belongs. A global resource can be used by any exploit in any scan session.

      The separation of the resources and the exploits in the resource objects **298** and the exploit objects **294** is a key idea in the architecture, and has substantial benefits. The scanner **37** can be more efficient because a resource required by

35      multiple exploits only needs to be created once, instead of once for each of the

exploits. The scanner **37** can also be more flexible because the resources and the exploits may be updated independently of each other. In addition, because the exploit objects **294** and the resource objects **298** can hide their implementation details behind standard interfaces, they may be managed and manipulated by an application, such as the scanner **37**, that does not know of their internal make-up. This can yield an architectural solution where the exploit need have no knowledge of the other exploits that produce or consume its resources.

The dat file **293** can store exploit attribute information for all of the exploits in the express update package **38**. There can be one dat file **293** for each exploit plug-in module **299**. When queried for its attribute information, the exploit reads the pertinent data from the dat file **293**. The separation of the exploit attribute information from the exploit object **294** itself allows the exploit object **294** and the dat file **293** to be updated independently. This separation also allows only some dat files **293** to be updated if other dat files **293** do not need to be updated or changed.

The help file **292** can contain on-line help information associated with the exploit objects **294** that can be contained in the exploit plug-in module **299**. When a user requests help, the scanner **37** can read the information from the file and display it in the UI **205**. The separation of the exploit's help information from the exploit object **294** can allow the help file **292** and the exploit object **294** to be updated independently of one another.

An exploit manager **230** manages the exploit objects **294** and a resource manager **220** manages the resource objects **298**. The exploit manager **230** and the resource manager **220** can access the exploit objects **294** contained in the exploit plug-in module **299** and the resource objects **298** contained in the resource plug-in module **297**. The exploit manager **230** and the resource manager **220** can convey exploit objects **294** and resource objects **298** to the policy manager **215** and plug-in engine **275**.

The UI **205** can exchange information with the user. The UI **205** can include a policy editor **210** and a policy manager **215**. The policy editor **210** can allow a user to examine, modify, create and configure policies; acquire on-line documentation about any exploit; perform keyword searches on the on-line documentation; and alter the current presentation of information based on category choices or search results. Policy information can be a scan configuration, consisting of a set of enabled exploits and any necessary parameters for those exploits. The policy manager **215** can pass exploit policy information to and from the policy editor **210** via a scanpolicy object

245. In addition, the policy manager **215** can acquire exploit objects **294** from the exploit manager **230** and resource objects **298** from the resource manager **220**, and then can create the scanpolicy objects **245**. A scanpolicy object **245** can be a container for policy information, and can expose interfaces enabling the scanner **37** components to query it for this information. When used in a scan session, the scanpolicy object **245** can be stored in a session object **240**.

The session object **240** can contain all information necessary to run a scan session. A scan session can run a series of exploits for one or more hosts. The engine **270** can query the session object **240**. The session object **240** can contain: the scanpolicy object **245** identifying enabled exploits and their parameters; a list of hosts to scan; a master exploit list **250**; a master resource list **255**, and a license file. The session object **240** can construct the master exploit list **250** and the master resource list **255**. The scanpolicy object **245** can be built by the policy manager **215** and the scanpolicy object **245** can be used to construct the master exploit list **250** and master resource list **255**. The master exploit list **250** can contain information about all the plug-in exploits **291** enabled for a scan session. For each plug-in exploit **291**, the master exploit list **250** can contain its exploit object **294** and information about any resource objects **298** produced or consumed by the exploit. The master resource list **255** can contain information about the resources needed for a scan session. For each resource, the list contains its resource object **298**, and information about any exploits that produce or consume the resource.

A session manager **235** can contain and manage the scan sessions as represented by session objects **240**. The session manager **235** can exchange scan configuration setting information with a thread manager **260**. The session manager **235** can ensure that host-scanning threads **265** are allocated equitably among the various session objects **240**. The UI **205** and the engine **270** can query the session manager **235** for information on what host to scan, scan configuration settings, etc. The thread manager **260** can get information from the session manager **235** that describes when a new session has been created, the number of hosts in a session and scan configuration parameters. The thread manager **260** can also create the host-scanning threads **265**. The host-scanning thread **265** can tell the thread manager **260** when it is finished with a scan session. Otherwise, the host-scanning thread **265** can communicate with the session manager **235** to get host information.

The engine **270** can run the built-in exploits. The plug-in engine **275** can be included in the engine **270** and can run the plug-in exploits **291**, and can contain the

target object **280** and a copy of the master exploit list **250** and master resource list **255**. The resources that are produced and consumed by various exploits can create dependencies among exploits. The plug-in engine **275** can run the plug-in exploits **291** in a particular order. There can be a plug-in engine **275** instance for each host.

5 The plug-in engine **275** can query the session manager **235** and can make its own copies of the master exploit list **250** and the master resource list **255**. The plug-in engine **275** can then use its copy of the master exploit list **250** and the master resource list **255** to run the plug-in exploits **291**. The master exploit list **250** and the master resource list **255** can have information on each exploit and resource. In particular,  
10 these lists **250** and **255** can be used to determine the order of running the plug-in exploits **291**.

The target objects **280** can be containers that provide a means of communication between the plug-in engine **275** and the exploit objects **294**. The plug-in engine **275** can create a target object **280**, and can reuse the same target object  
15 **280** for each plug-in exploit **291** run against a host. Before executing the plug-in exploit, the plug-in engine **275** can query the exploit object **294** for information on the resources it requires. The plug-in engine **275** can acquire the required resource objects **298** from the resource manager **220** and can put them into the target object **280**. The target object **280** can pass the required resource objects **298** into the exploit  
20 object **294**. The plug-in exploit **291** can then be run, and the exploit object **294** can pass the scan result information into the target object **280**. The target object **280** can then return this scan result information to the plug-in engine **275**, which updates the UI **205**, the database **290**, and the scanner log file **295**.

## 25 **The Screen Displays**

Turning now to FIGS. 3-7, screen displays showing the UI **205** component for an exemplary embodiment of the present invention are shown.

FIG. 3 is a screen display of the detailed information in an Inventory folder the user can access in an exemplary embodiment of the present invention. Under an  
30 Inventory folder **305**, there can be a FlexChecks folder **320** and a Common Settings folder **310**. The FlexChecks folder **320** can enable a user to write his own checks or exploits to plug in the scanner **37**. The Common Settings folder **310** can contain global settings that can be enabled for a policy. These settings may apply to multiple vulnerability checks. An example of information found in the Common Settings  
35 folder **310** is the HTTP Ports folder **315**. This folder can have two options for using

the HTTP Ports setting. One option, the HTTP Ports option **325** allows the user to default and look for port 80 or port 8080, in addition to looking for the specified port. The HTTP Secure Ports option **330** can only look for the specified port or ports.

FIG. 4 is a screen display of the detailed information the user can access in a Vulnerabilities folder in an exemplary embodiment of the present invention. The Vulnerabilities folder **405** can contain and describe the exploits that check the holes in the operating system **36** which could allow an intruder to gain information and allow improper access. Under the Vulnerability folder **405**, there can be a Denial-of-Service folder **410** and a Standard folder **425**. The Denial-of-Service folder **410** lists the exploits that have the potential of shutting down a system or service. These include the E-mail **415** and Instant Messaging **420** categories.

The Standard folder **425** can hold numerous categories of standard vulnerabilities, including Backdoors, Browser, E-mail, and Firewalls categories. The exploit details that can be shown in the Vulnerabilities folder **405** include: risk levels, attack names, platforms, descriptions, remedies, references, common vulnerabilities and exposures (CVE), and links to other sources.

FIG. 5 is a screen display of information a user can access in a Services folder in an exemplary embodiment of the present invention. The Services folder **505** can list the types of services that the scanner **37** will attempt to connect to on the user's network. The Service folder **505** can include information such as transmission control protocol (TCP) Services **510**, which can attempt to connect to all well-known TCP-based service ports.

FIG. 6 is a screen display of information a user can access in an Accounts folder in an exemplary embodiment of the present invention. The Accounts folder **605** can list the types of accounts the scanner **37** checks as it scans the user's network. When accessing the Accounts folder **605**, the UI **205** can access an list of accounts under a particular folder's name. For example, a NetBIOS folder **610** can check for accounts with NetBIOS names that can be used to identify a computer. A NetBIOS is an application programming interface (API) that can be used by application programs on a local area network.

FIG. 7 is a screen display showing the different views the user can access in an exemplary embodiment of the present invention. A Standard View **705** can be the default view that displays the exploits in a normal order. A Module View **710** can display which exploits are contained in which plug-in modules. A Risk View **715** can display the exploits in folders according to their level of risk: high, medium, or low.

A Category View **720** can display the exploits according to what category of vulnerability it falls under. Some examples of the Category View **720** are E-mail vulnerabilities or Backdoor vulnerabilities. A Built-in/Plug-in View **725** allows the user to see which exploits are built-in exploits and plug-in exploits **291**. Outside of this view in the policy editor **210**, the user cannot distinguish between the plug-in exploits **291** and built-in exploits. The user cannot distinguish this difference because each built-in exploit has a dummy plug-in object. The dummy plug-in object can be stored in the exploit plug-in module **299**. The dummy plug-in objects can look like the regular plug-in exploit objects **294** but they are never executed. The UI **205**, the policy manager **215**, and the help file **292** can access the dummy plug-in object.

### The Plug-in Capability

FIG. 8 is flowchart diagram illustrating an exemplary method for identifying, fixing, and updating security vulnerabilities in a host computer or computers. In routine **805**, the scanner **37** can initialize. In routine **810**, the UI **205** can get the license, policy, and host information. In step **811**, the policy manager **215** can create the scanpolicy object **245**. In routine **812**, the policy editor **210** can allow the policy information to be edited. The policy information includes which exploits are enabled, configuration parameters, and common-setting resources. In step **815**, the user can initiate a scan. In step **820**, the UI **205** can create the session object **240** and the session object **240** can use the scanpolicy object **245** to create the master exploit list **250** and the master resource list **255**. In step **825**, the UI **205** can register the session object **240** with the session manager **235**. In step **830**, the thread manager **260** can start host-scanning threads **265** for the scan session. In step **835**, the first host-scanning thread can ask the session manager **235** for host, license, and policy information. In routine **840**, the engine **270** can run the exploits. In step **845**, the engine **270** can repeat steps **835-840** for the remaining hosts in the scan session.

### Initializing a Scanner

FIG. 9 is a flowchart diagram illustrating an exemplary routine **805** for initializing a scanner **37** as set forth in FIG. 8. In step **905**, the exploit manager **230** and resource manager **220** can enumerate the installed exploit plug-in modules **299**, resource plug-in modules **297**, exploit objects **294**, and resource objects **298**. In routine **910**, load security can be run for each exploit plug-in module **299** and

resource plug-in module 297, and these plug-in modules 299 and 297 can be loaded in the scanner 37. In routine 915, the policy manager 215 can initialize.

FIG. 10 is a flowchart diagram illustrating an exemplary routine 910 for running load security and loading the plug-in modules 299 and 297 in the scanner 37 as set forth in FIG. 9. In step 1005, the scanner 37 and plug-in modules 299 and 297 can be digitally signed prior to release. In step 1010, the exploit manager 230 can run load security on the exploit plug-in modules 299 and the resource manager 220 can run load security on the resource plug-in modules 297. The purpose of load security can be to ensure that only legitimate applications (such as a legitimate scanner 37) may load the plug-in modules 299 and 297 and that the scanner 37 only loads legitimate plug-in modules 299 and 297. Load security can verify the digital signature of the plug-in modules 299 and 297. In step 1011, if the digital signature is incorrect, the load security is unsuccessful, and the scanner 37 will not load the plug-in modules 299 and 297. In step 1015, if the digital signature is correct, then the load security is successful, and the exploit manager 230 can load the exploit plug-in module 299 into the scanner 37, and the resource manager 220 can load the resource plug-in module 297 into the scanner 37. In step 1020, the plug-in module 299 or 297 can run load security, and can verify the digital signature of the scanner 37. In step 1021, if load security is unsuccessful, the plug-in module 299 or 297 can remove itself from the scanner 37. In step 1025, if load security is successful, the exploit plug-in module 299 can allow the exploit manager 230 to access its internal functions, or the resource plug-in module 297 can allow the resource manager 220 to access its internal functions.

FIG. 11 is a flowchart diagram illustrating an exemplary routine 915 for initializing the policy manager 215 as set forth in FIG. 9. In step 1105, the policy manager 215 can ask the exploit manager 230 and resource manager 220 what exploits and resources are available. In step 1110, the exploit manager 230 and resource manager 220 can go to the registry 285 to find out what exploits and resources are available. In step 1115, the exploit manager 230 and the resource manager 220 can create maps indicating which of the plug-in modules 299 or 297 contain the available exploit objects 294 and the available resource objects 298. In step 1120, the policy manager 215 can ask the exploit manager 230 and the resource manager 220 to get all the exploits objects 294 and common-setting resource objects 298. The common-setting resource objects 298 can contain configuration information that can be used by multiple exploits. In routine 1125, activation security can be run



to ensure that the scanner 37 and the exploit objects 294 and resource objects 298 are legitimate, and the available exploit objects 294 and common-setting resource objects 298 can be created. In step 1130, the exploit manager 230 can get the exploit objects 294 and the resource manager 220 can get the resource objects 298. The exploit manager 230 can return the exploit objects 294 and the resource manager 220 can return the resource objects 298 to the policy manager 215. The policy manager 215 can then query the exploit objects 294 and resource objects 298 for exploit attribute and resource configuration information.

FIG. 12 is a flowchart diagram illustrating an exemplary routine 1125 for running activation security and creating the available exploit objects 294 and resource objects 298 as set forth in FIG. 11. Activation security can implement a modified SKID3 protocol exchange where both sides demonstrate their knowledge of a shared secret. In step 1205, the exploit manager 230 and the resource manager 220 can find out if the exploit plug-in module 299 or the resource plug-in module 297 know the shared secret. In step 1206, if the exploit plug-in module 299 or the resource plug-in module 297 do not know the shared secret, the exploit manager 230 or resource manager 220 can refuse to create the exploit object 294 or resource object 298. In step 1210, once the plug-in module 299 or 297 has demonstrated its knowledge of the shared secret, the exploit manager 230 or resource manager 220 can demonstrate its knowledge of the shared secret. In step 1211, if the exploit manager 230 or the resource manager 220 do not know the shared secret, the plug-in module 299 or 297 can refuse access to its class factory. The class factory can be used to build the instances of the exploit object 294 or resource object 298. In step 1215, if the exploit manager 230 or the resource manager 220 has demonstrated its knowledge of the shared secret, the exploit manager 230 or resource manager 220 can allow access to the class factory to create the exploit object 294 or resource object 298 contained in the plug-in module 299 or 297.

#### **Getting License, Policy and Host Information**

FIG. 13 is a flowchart diagram illustrating an exemplary routine 810 for getting license, policy and host information as set forth in FIG. 8. In step 1305, the UI 205 can specify the license information. In routine 1310, the UI 205 can specify the policy information. In step 1315, the UI 205 can specify the host information.

FIG. 14 is a flowchart diagram illustrating an exemplary routine 812 for getting policy information as set forth in FIG. 8. In step 1410, the policy editor 210

can allow the user to examine, modify and configure the policy settings of the available exploits and resources. In step **1415**, the policy editor **210** can store the choices in a policy file.

### 5            **Running Exploits**

FIG. 15 is a flowchart diagram illustrating an exemplary routine **840** for running the exploits as set forth in FIG. 8. The engine **270** includes a plug-in engine **275**. The exploits can be denial-of-service (DoS) exploits or standard exploits. A DoS exploit may initiate a condition on a scanned host that damages its ability to perform some needed function. Typical DoS exploits may crash a running service. More severe DoS exploits may crash the host itself. DoS exploits, if enabled, can be scheduled to execute last to avoid interfering with the scanner's **37** ability to successfully execute other exploits. The standard exploits can be exploits that do not initiate a DoS condition. In routine **1505**, the engine **270** can run the standard built-in exploits. In routine **1510**, the plug-in engine **275** can run the standard plug-in exploits **291**. In routine **1515**, the plug-in engine **275** can run the DoS plug-in exploits **291**. In routine **1520**, the engine **270** can run the DoS built-in exploits.

FIG. 16 is a flowchart diagram illustrating an exemplary routine **1505** or **1520** for running the built-in exploits as set forth in FIG. 15. The built-in exploits are in a list and the engine **270** can attempt to run the built-in exploits in the order they are put in the list. However, the engine **270** cannot run a built-in exploit if its resources are not yet available. Other exploits may need to be run to create the resources needed to run a particular built-in exploit. Multiple passes through the list may thus be necessary for the engine **270** to run all the built-in exploits in the list. In step **1605**, the engine **270** can attempt to run the exploit at the top of the built-in exploit list. In step **1610**, the engine **270** can record the scan result information to the database **290** and the scanner log file **295** and sends the scan result information to the UI **205** to display. In step **1615**, the engine **270** can repeat steps **1605-1610** for the remaining built-in exploits in the list.

FIG. 17 is a flowchart diagram illustrating an exemplary routine **1510** or **1515** for running the plug-in exploits **291** as set forth in FIG. 15. In step **1705**, the session object **240** can use the scanpolicy object **245** to create the master exploit list **250** and the master resource list **255**. In step **1710**, the plug-in engine **275** can make copies of the master exploit list **250** and the master resource list **255**. In step **1715**, the plug-in engine **275** can get the host information and resources for the first exploit. In step

1720, the plug-in engine 275 can create a target object 280. In step 1721, the plug-in engine 275 can put the host information and resources in the target object 280. In step 1725, the plug-in engine 275 can pass the target object 280 to the exploit object 294. In step 1730, the plug-in engine 275 can run the plug-in exploit 291. In step 1735, the exploit object 294 can add the log and scan result information to the target object 280. In step 1740, the exploit object 294 can pass the target object 280 back to the plug-in engine 275. In step 1745, the plug-in engine 275 can query the target object 280 for the log and scan result information. In step 1750, the plug-in engine 275 can record the scan result information to the database 290 and the scanner log file 295 and sends it to the UI 205 for display. In step 1755, the plug-in engine 275 can get the host and resource information for the next exploit and can repeat steps 1721-1750.

FIG. 18 is a flowchart diagram illustrating an exemplary method for determining the optimal order for running both the standard and the DoS plug-in exploits 291. The existence of shared resources that are produced and consumed by various exploits can imply possible dependencies among exploits. These possible dependencies can exist only for mandatory resources. The plug-in engine 275 can schedule all producers of a mandatory shared resource to execute before any of the consumers of that resource. Each plug-in engine 275 can make a copy of the master exploit list 250 and master resource list 255 for each scanned host because the copied master lists 250 and 255 can continually change during each host scan.

The master exploit list 250 can be divided into four sections. The first section can include the exploits that neither produce nor consume resources. In step 1805, the plug-in engine 275 can first run these plug-in exploits 291.

The second section of the master exploit list 250 can include the exploits that only produce resources. In step 1810, the plug-in engine 275 can run these plug-in exploits 291. After each exploit is run, the copied master resource list 255 can be updated to indicate which resources have been created.

The third section of the master exploit list 250 can include the exploits that both produce and consume. In step 1815, the plug-in engine 275 can run these plug-in exploits 291. The plug-in engine 275 can ask each of these exploits which resources the exploit needs to run. For example, the copied master exploit list 250 can indicate that exploit 1 needs resources A, B, and C to run. The plug-in engine 275 can then go to the copied master resource list 255 and find out that exploits 5, 8, and 10 need to run to produce resources A, B, and C. Exploits 5, 8 and 10 can be run, producing A, B, and C. Then exploit 1 can be run using A, B, and C. This procedure

of scheduling exploits that produce required resources to run prior to consumers of those resources can apply to exploits 5, 8, and 10. To make the process run smoothly, cyclic dependencies can be disallowed. Dependencies of standard exploits on DoS exploits can also be disallowed.

- 5           The fourth section of the master exploit list **250** can include the exploits that only consume resources. In step **1820**, the plug-in engine **275** can run these plug-in exploits **291** last.

### **Conclusion**

- 10           The present invention has been described in relation to particular embodiments which are intended in all respects to be illustrative rather than restrictive.

- Alternative embodiments will become apparent to those skilled in the art to which the present invention pertains without departing from its spirit and scope. Accordingly, the scope of the present invention is defined by the appended claims  
15 rather than the foregoing description.

### Claims

1. A computer-implemented process for identifying security vulnerabilities in a host computer system via a scanner, including the steps of:

5        passing exploit objects, which contain exploits that check a host computer system for vulnerabilities and resource objects, which contain resources which can be used by the scanner, from an exploit manager and a resource manager to an engine of the scanner; and

10        executing exploits, which check a host computer system for vulnerabilities, contained in the exploit objects via the engine to identify security vulnerabilities in the host computer system.

2. A computer-implemented process for identifying security vulnerabilities in a host computer system via a scanner, including the steps of:

15        installing an express update package containing: an exploit plug-in module containing exploit objects, which contain exploits that check a host computer system for vulnerabilities; a resource plug-in module containing resource objects, which contain resources which can be used by the scanner; a dat file, which contains exploit attribute information; and a help file, which contains on-line help information, on a  
20        computer;

         supplying exploit attribute information to an exploit manager from a dat file;  
         passing exploit object and resource object information from the exploit manager and the resource manager to an engine of the scanner; and  
         executing exploits.

25

3. The computer-implemented process of claim 2 wherein said resources can be assigned a namespace based upon the resource's scope.

4. The computer-implemented process of claim 2, wherein said step of executing  
30        exploits includes the steps of:

         running standard built-in exploits;  
         running standard plug-in exploits;  
         running denial of service plug-in exploits; and  
         running denial of service built-in exploits.

35

5. The computer-implemented process of claim 4, wherein said steps of running standard and denial of service built-in exploits includes the steps of:

- having the engine get the exploit at the top of a run-order list;
- having the engine attempt to run the exploit;
- 5 if the exploit is run, recording the exploit result information to a database and a scanner log file;
- sending the exploit result information to a user interface to display; and
- repeating the above steps for the remaining exploits.

10 6. The computer-implemented process of claim 4, wherein said steps of running standard and denial of service plug-in exploits includes the steps of:

- having the plug-in engine make copies of the master exploit list (a list of exploits and the resources the exploits produce and consume) and the master resource list (a list of resources and the exploits that produce and consume those resources)
- 15 from the session object;
- getting exploit information from the scanpolicy object for the first exploit;
- creating a target object and putting the exploit information in the target object;
- passing the target object to the exploit object;
- running the exploit;
- 20 adding exploit result information to the target object;
- passing the target object back to a plug-in engine;
- querying the target object for exploit result information;
- recording exploit result information to the scanner log file and sending the exploit result information to the user interface; and
- 25 repeating the above steps for the remaining exploits.

7. The computer-implemented process of claim 6, wherein said step of repeating the above steps for the remaining exploits includes the steps of:

- running exploits that neither produce nor consume shared resources;
- 30 running exploits that only produce shared resources;
- running exploits that produce and consume shared resources; and
- running exploits that only consume shared resources.

8. The computer-implemented process of claim 7, wherein said step of running exploits that produce and consume shared resources includes the step of ensuring that all producers of resources consumed by the exploit are run before the exploit is run.

5 9. The computer-implemented process of claim 2, further including the step of initializing a scanner.

10. The computer-implemented process of 9, wherein the step of initializing a scanner includes the steps of

10 enumerating plug-in modules and objects;  
running load security for each plug-in module;  
initializing a policy manager.

15 11. The computer-implemented process of 10, wherein the step of initializing a policy manager includes the steps of:

asking an exploit manager and a resource manager to identify available exploits and resources;

having the exploit manager and the resource manager query the registry for available exploit objects and the available resource objects;

20 having the exploit manager and the resource manager create maps indicating which plug-in modules contain the available exploit objects and the available resource objects;

having a policy manager ask the exploit manager and resource manager for the available exploit objects and common-setting resource objects;

25 creating the available exploit objects and common-setting resource objects;

having the policy manager query the available exploit objects and common-setting resource objects.

30 12. The computer-implemented process of claim 2, including the step of getting license, policy and host information.

13. The computer-implemented process of claim 12, wherein said step of getting policy information includes the steps of:

- having the policy manager create a scanpolicy object;
- having a policy editor examine, modify and configure exploit and resource
- 5 policy settings; and
- having the policy editor store the user choices in a policy file.

14. The computer-implemented process of claim 13, wherein said step of having a policy manager create the scanpolicy object includes the steps of:

- 10 having the policy editor query the policy manager for policy information about an exploit; and
- having the policy manager give the policy information to the policy editor.

15. The computer-implemented process of 2, including the steps of:

- 15 having host-scanning threads query a session manager for available hosts to scan;
- having the session manager query the session objects for the next host; and
- having the session manager return the host to the host-scanning thread.

- 20 16. The computer-implemented process of claim 2, wherein the step of running security checks is included.



## METHOD AND SYSTEM FOR IDENTIFYING, FIXING, AND UPDATING SECURITY VULNERABILITIES

5

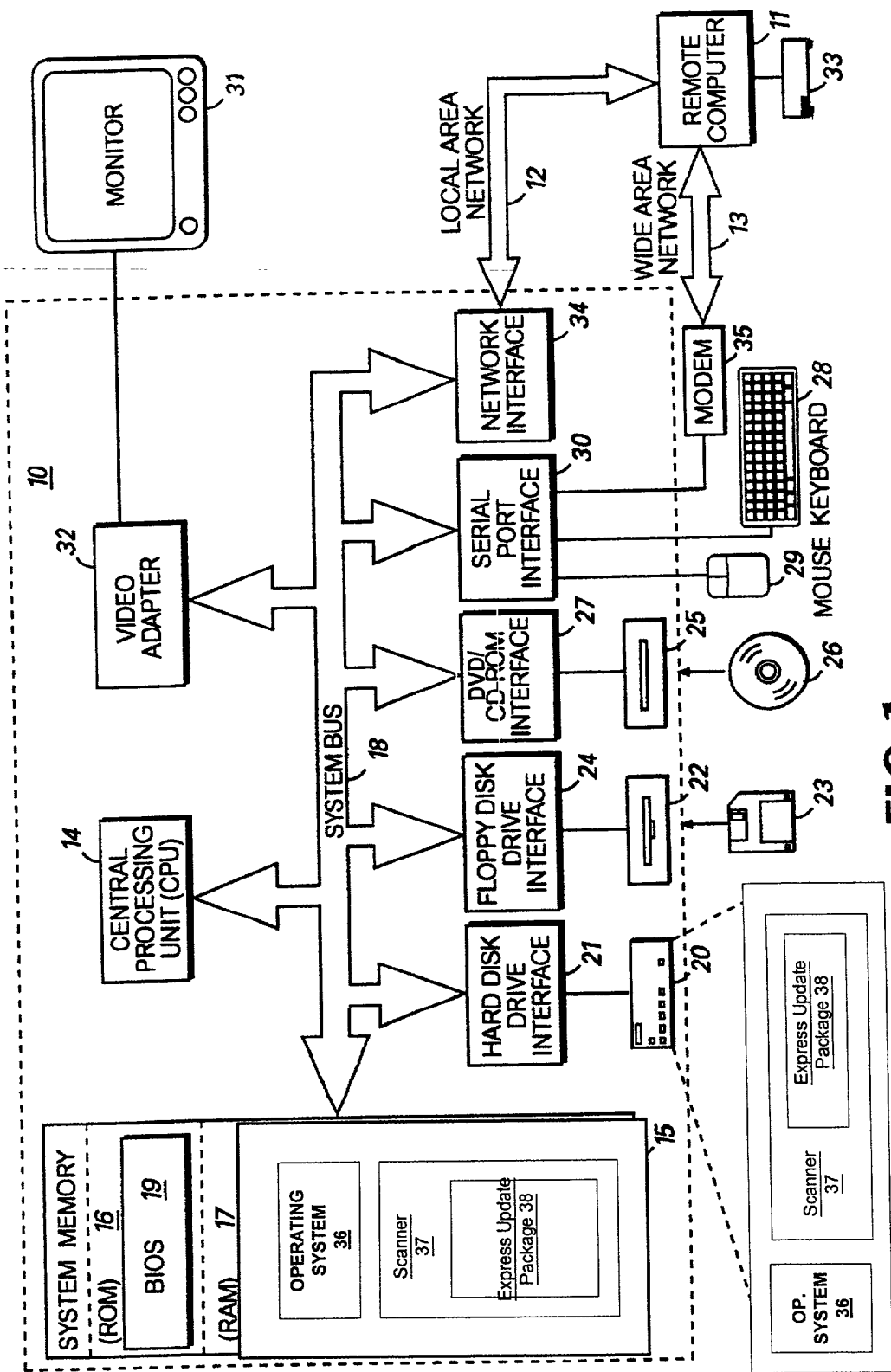
### Abstract

A method and system identifies, fixes, and updates security vulnerabilities in a host computer or host computers. The present invention can communicate between a scanner with plug-in capability, an operating system, and an express update package.

10 The architectural set-up can allow exploits within the scanner and exploits in the express update package to function with no knowledge of each other. The user also needs no knowledge of whether the exploits are within the scanner or the express update package. Mutual authentication procedures can enable the scanner to load only legitimate express update packages, and can provide that express update packages can only be loaded into legitimate scanners.

15

20 K&S Docket No. 05456.105002



**FIG.1**

**FIG. 2**

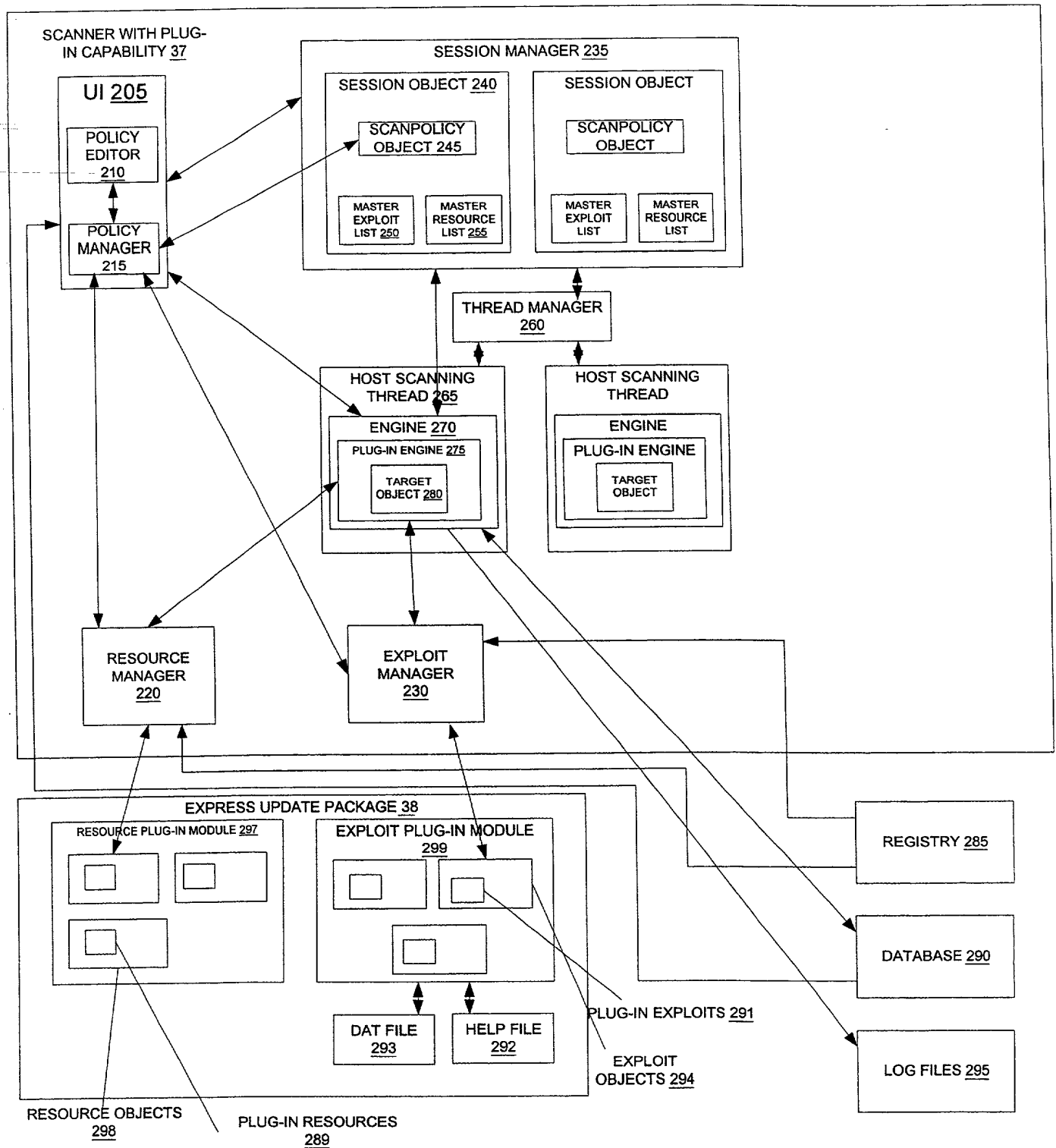
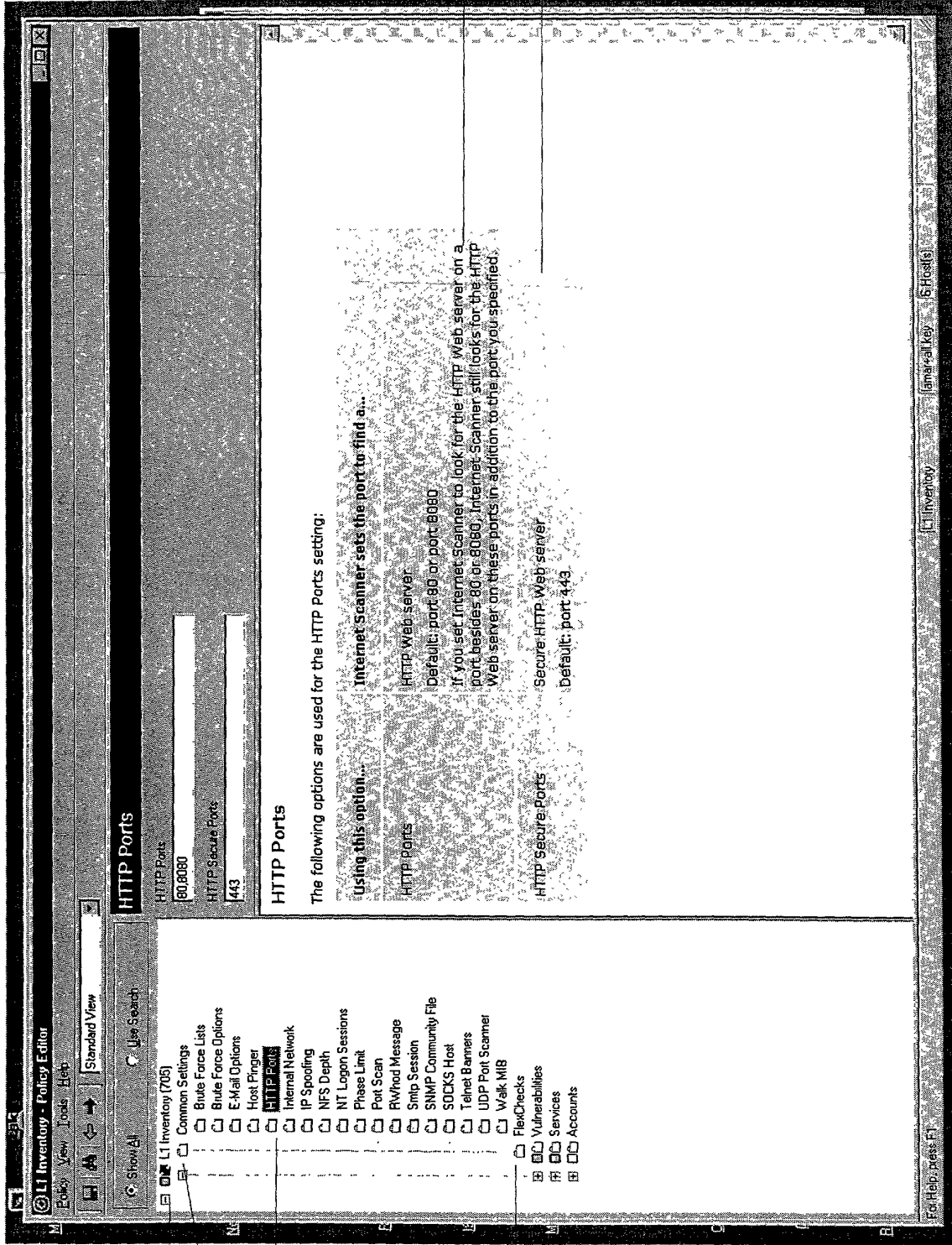


FIG. 3



305

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315

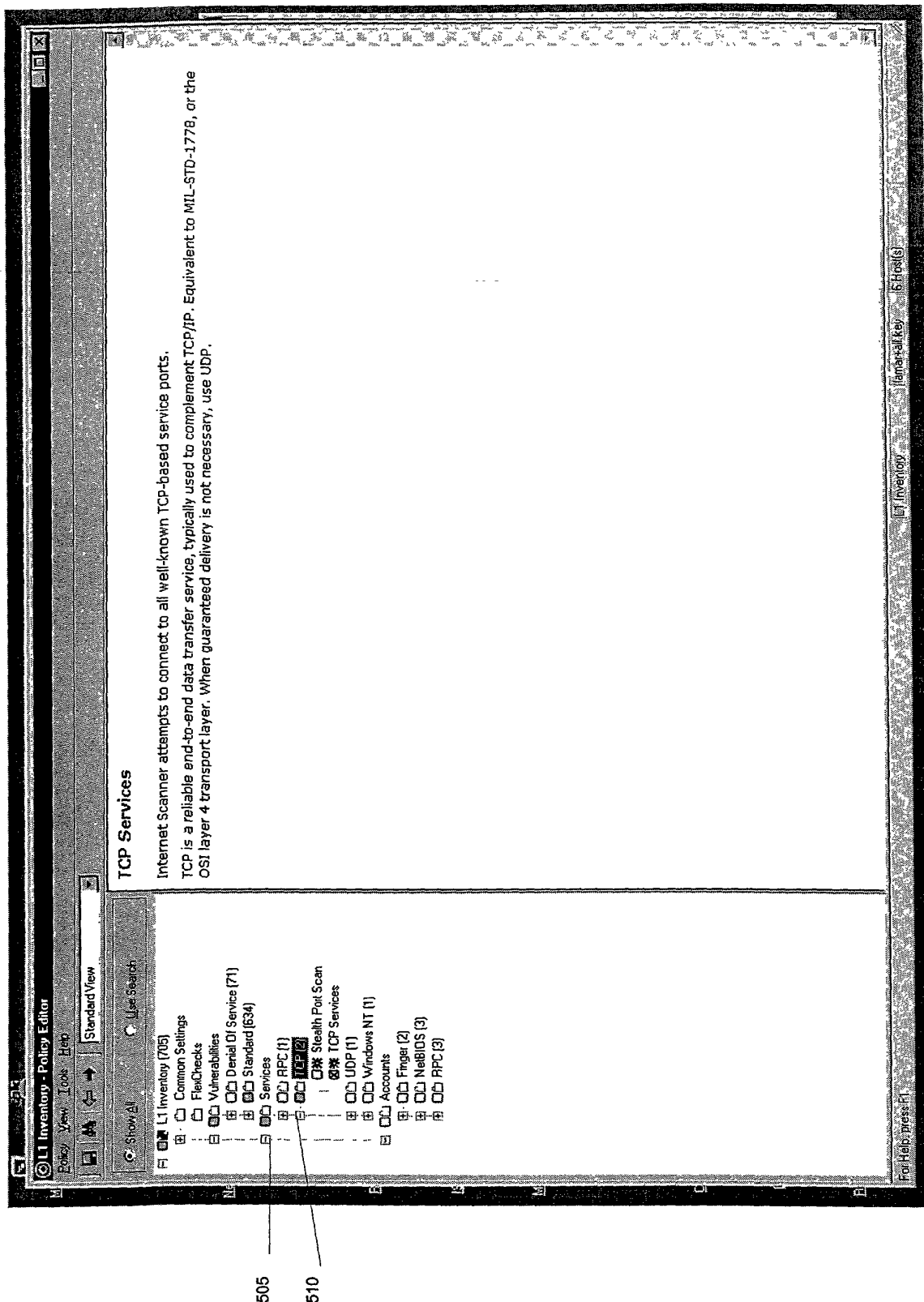
320

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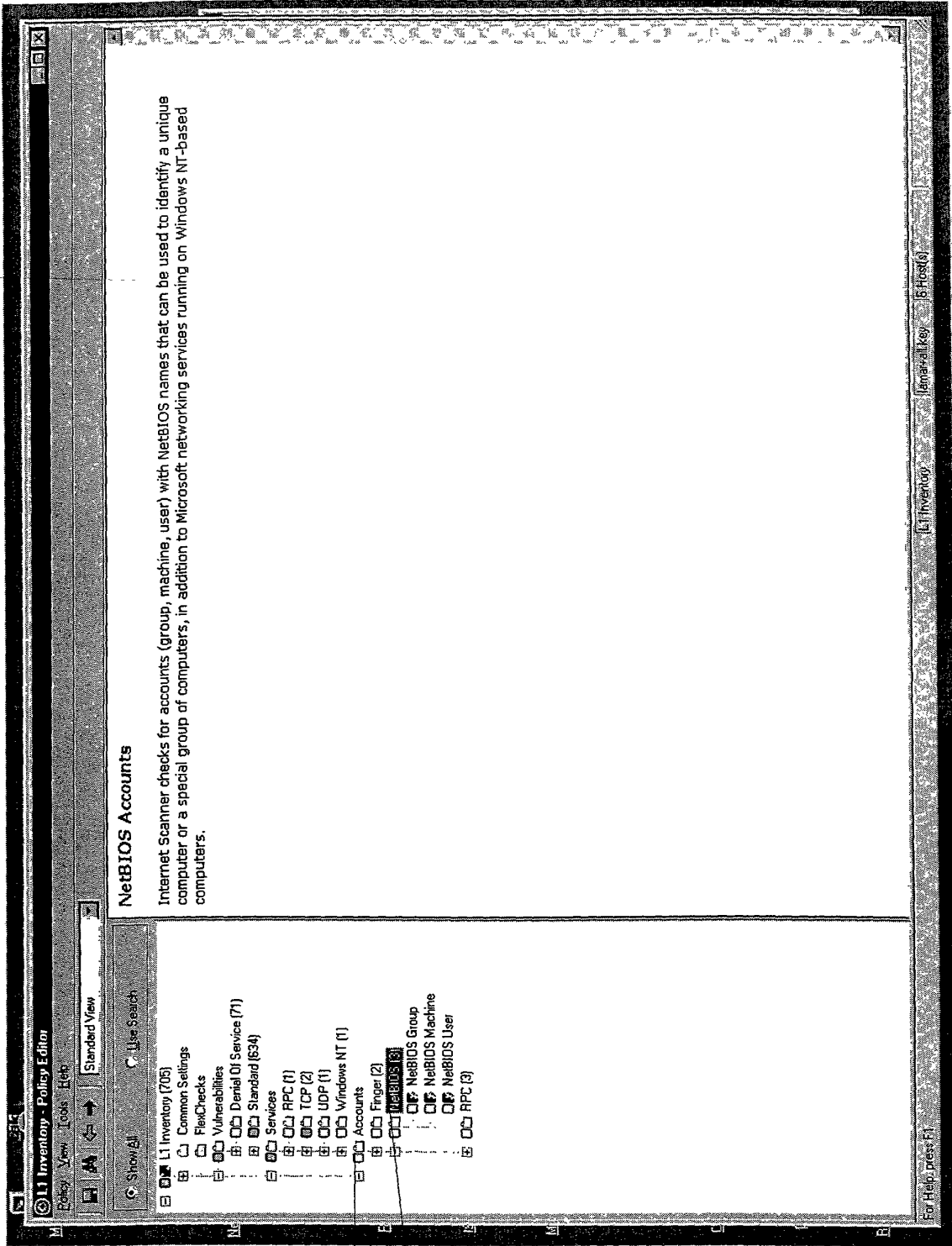
330



**FIG. 5**



**FIG. 6**

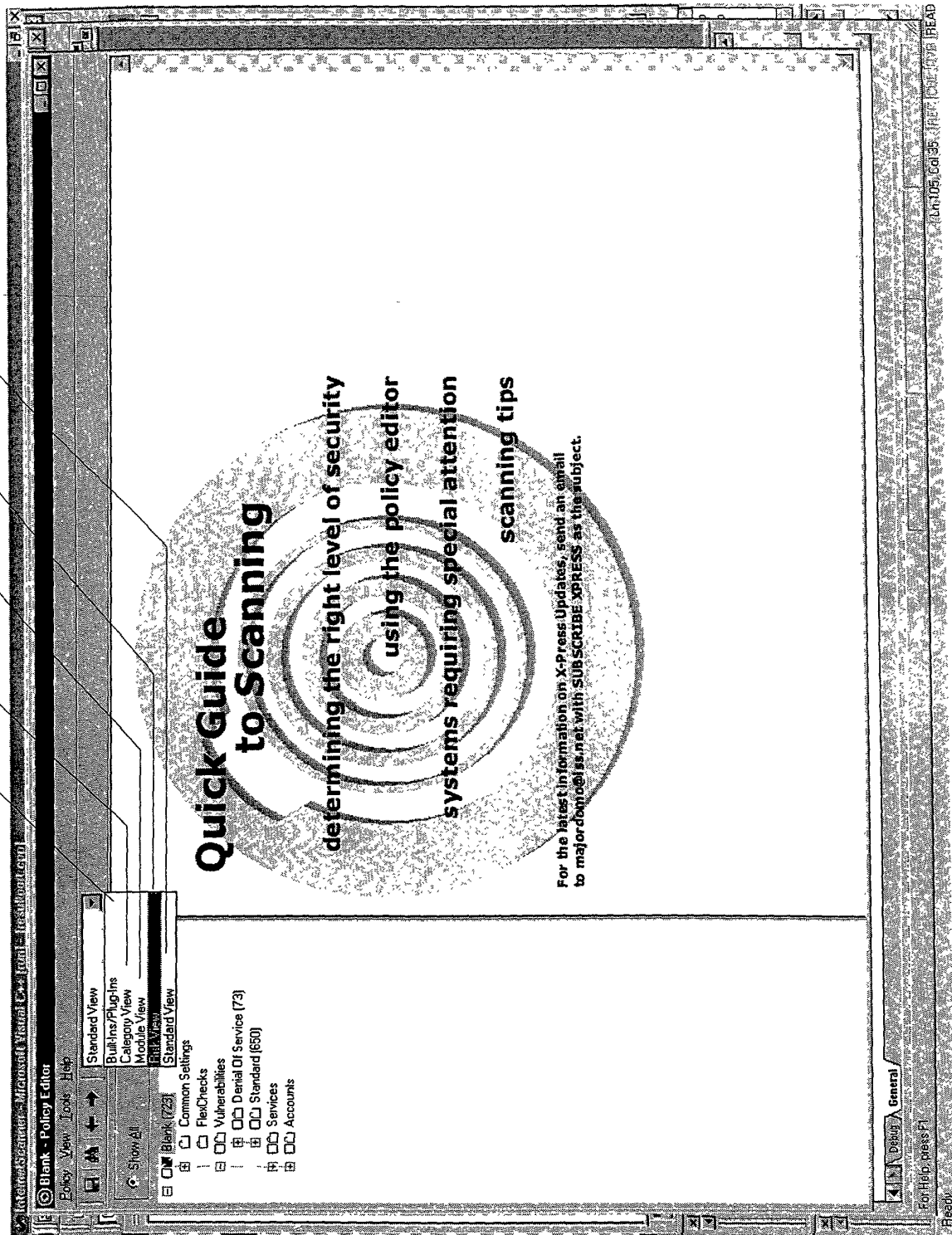


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610

**FIG. 7**

725 720 710 715 705





**FIG. 8**

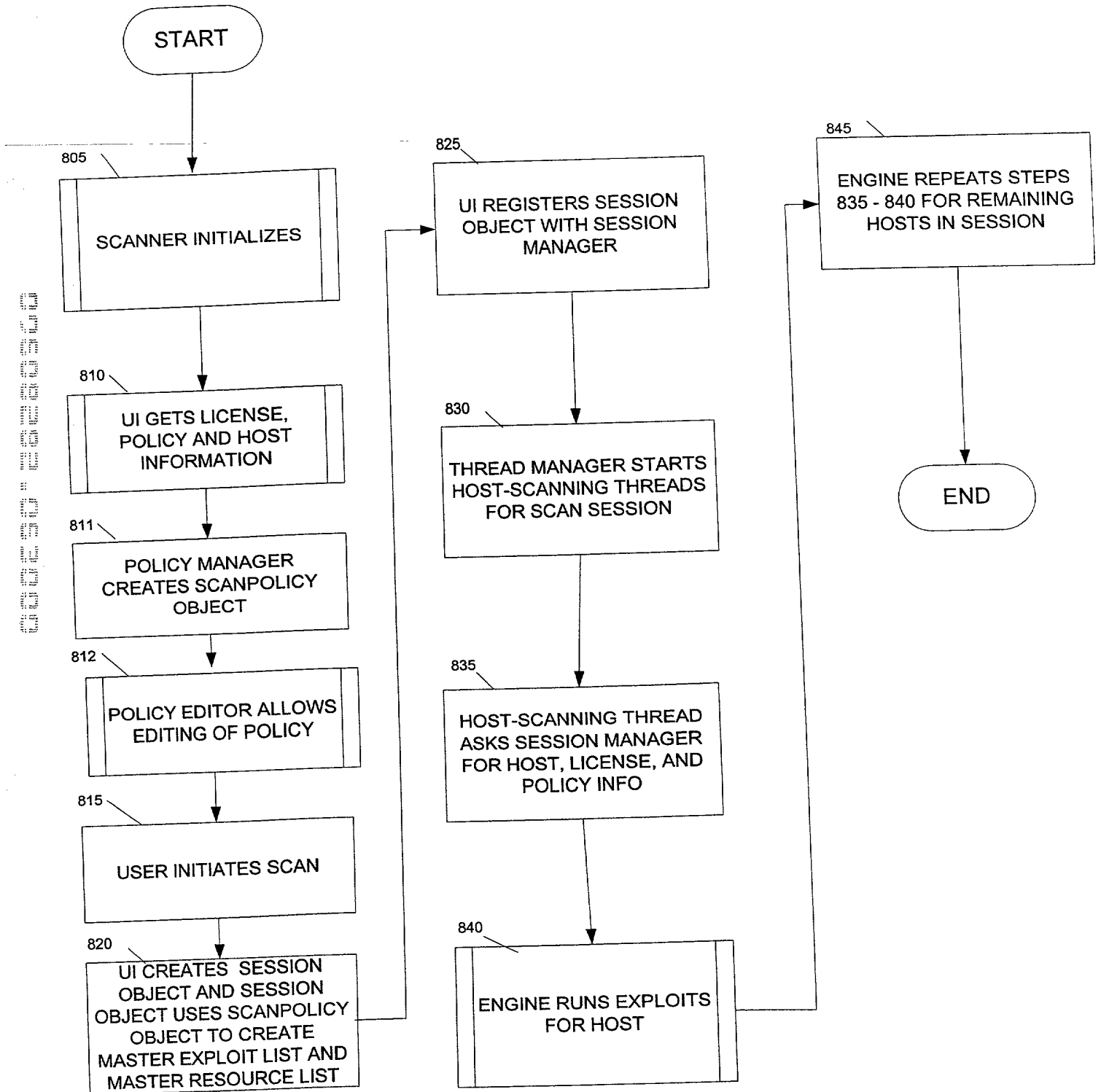


FIG. 9

805

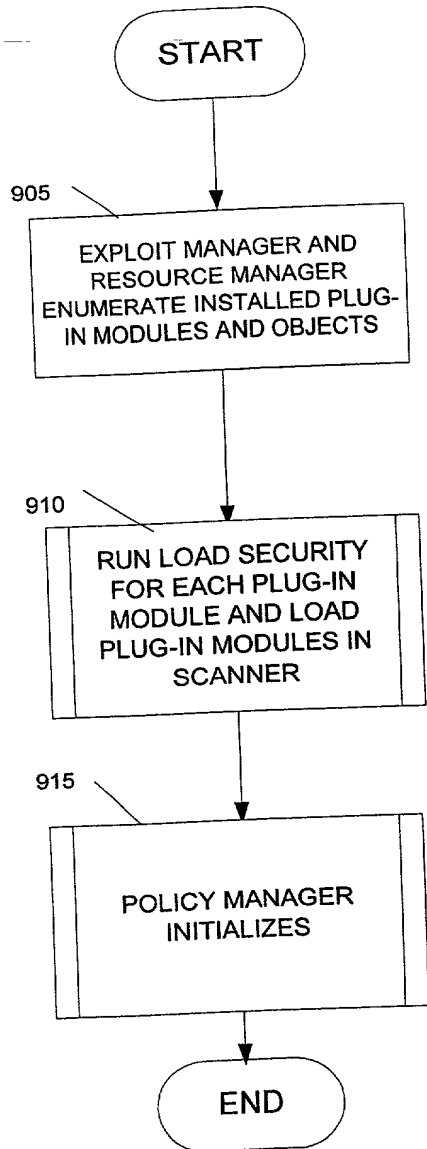


FIG. 10

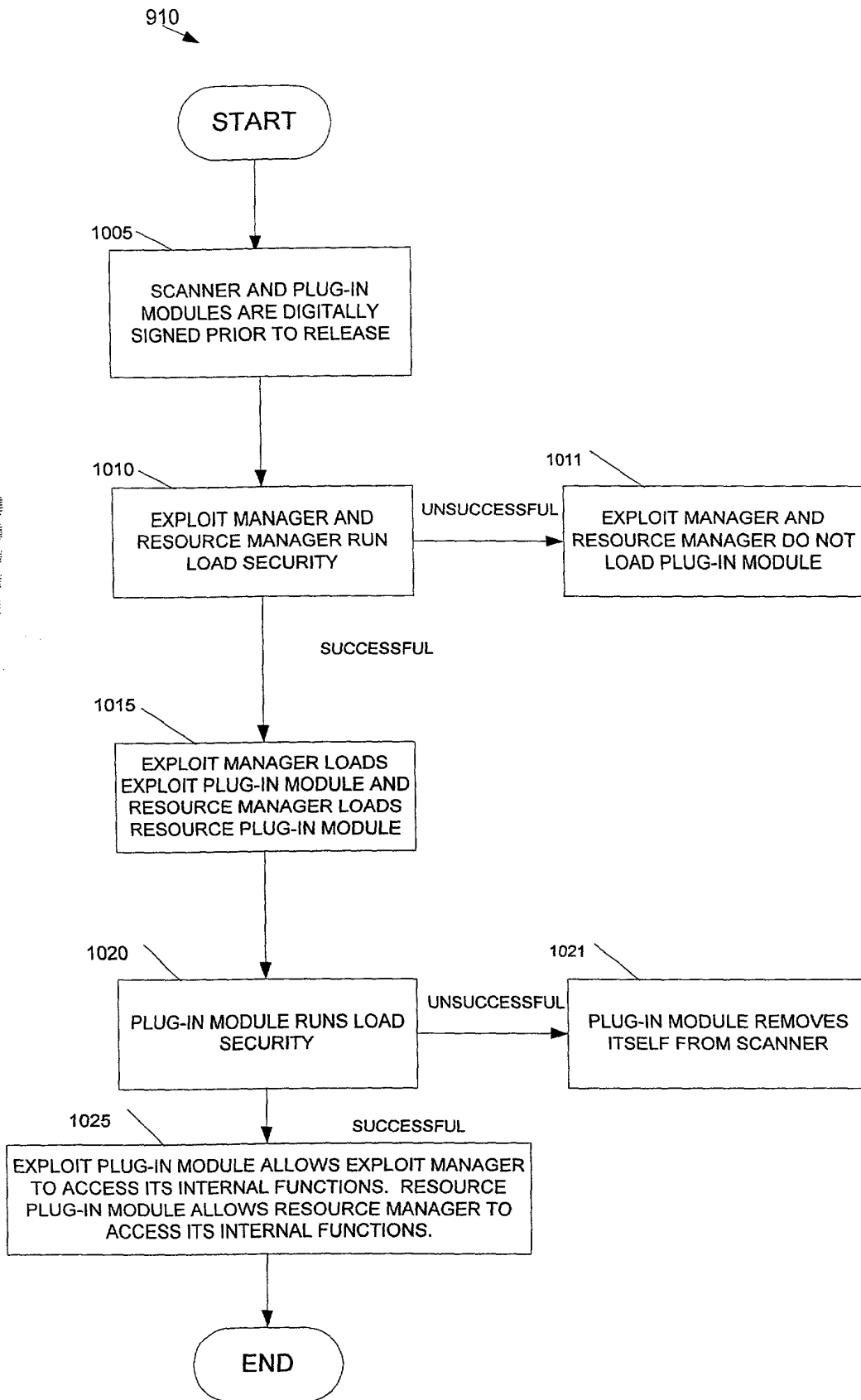


FIG. 11

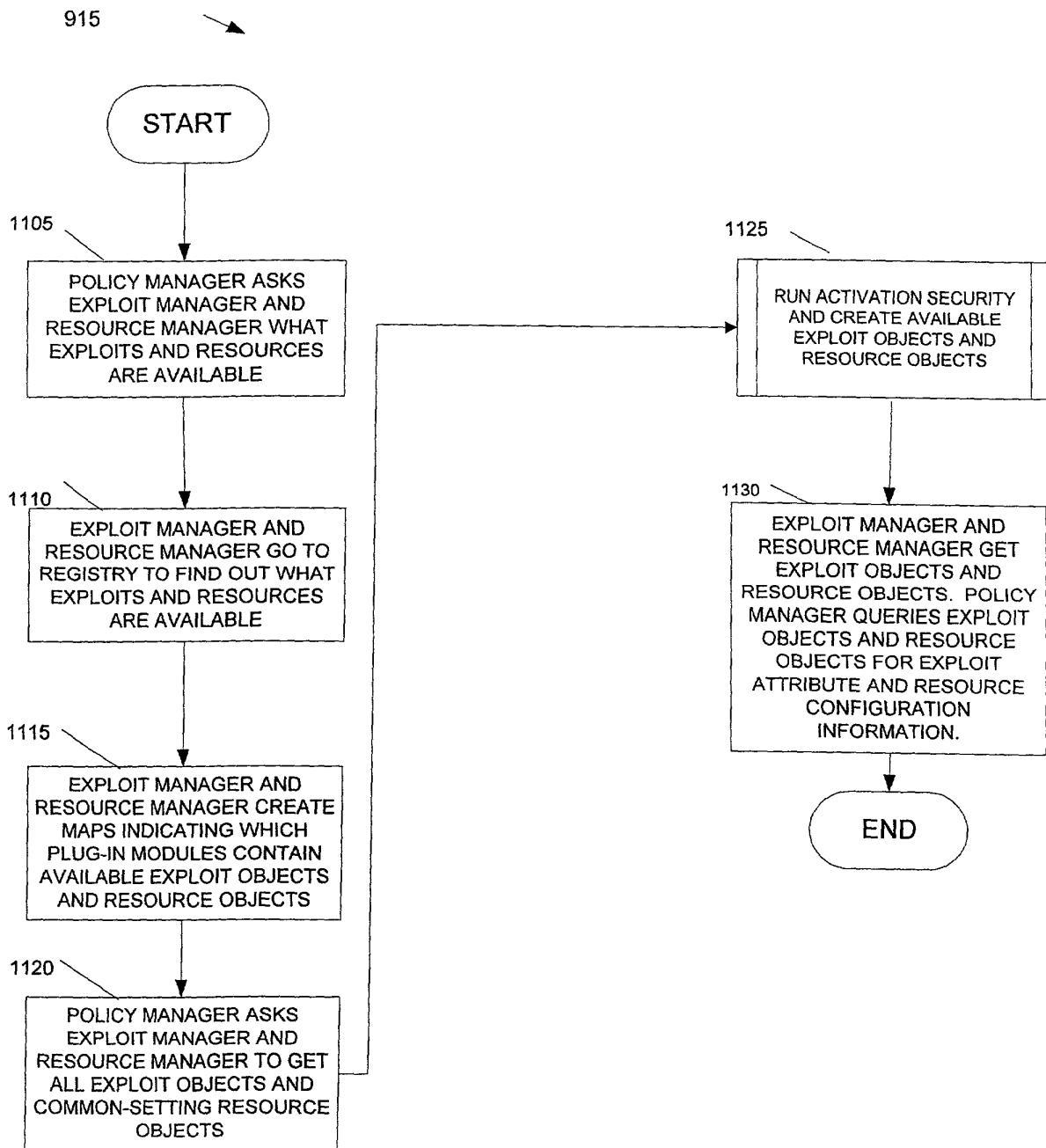


FIG. 12

1125

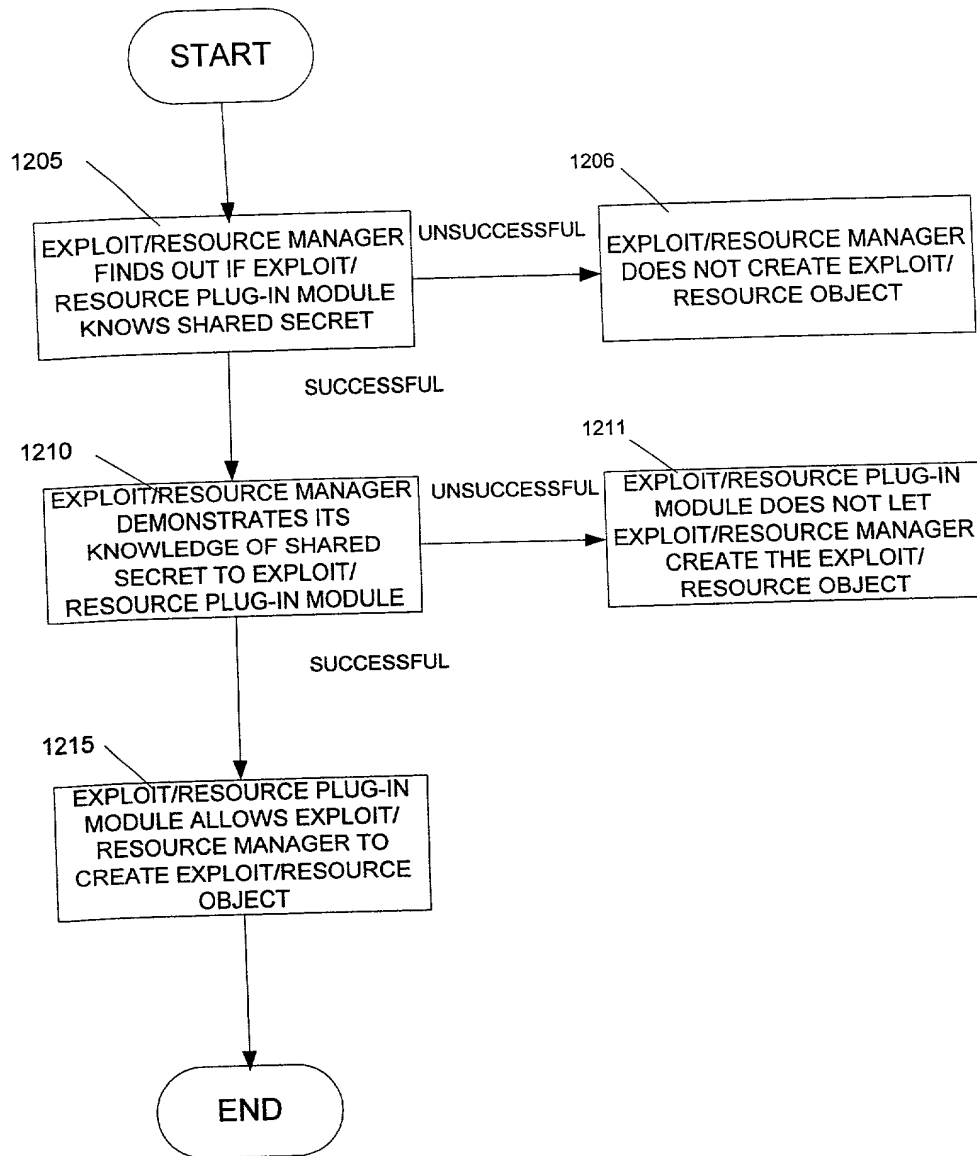


FIG. 13

810

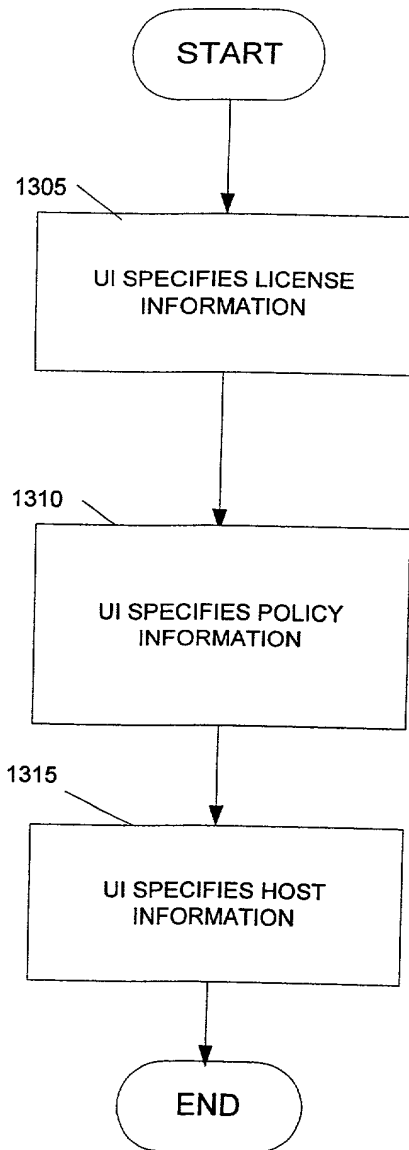
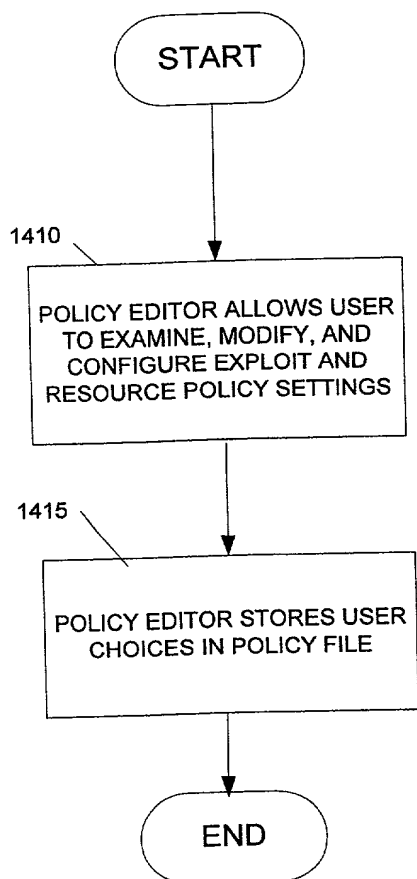


FIG. 14

812



840

FIG. 15

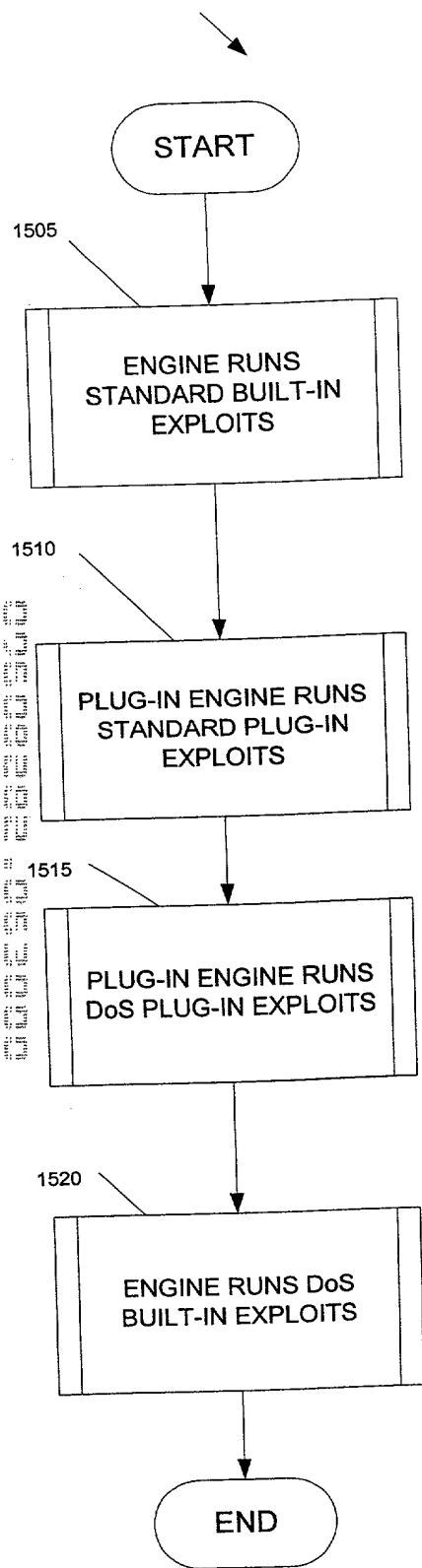
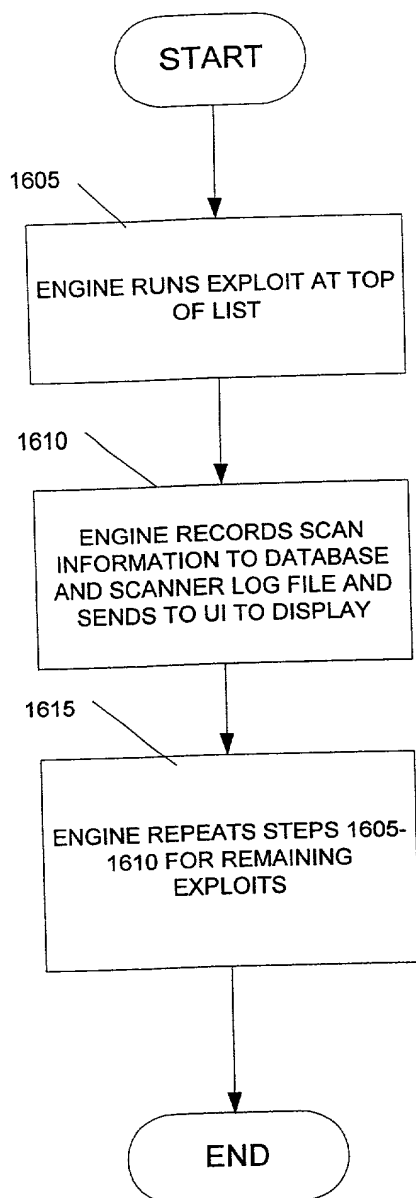




FIG. 16

1505 or 1520



**FIG. 17**

1510 or 1515

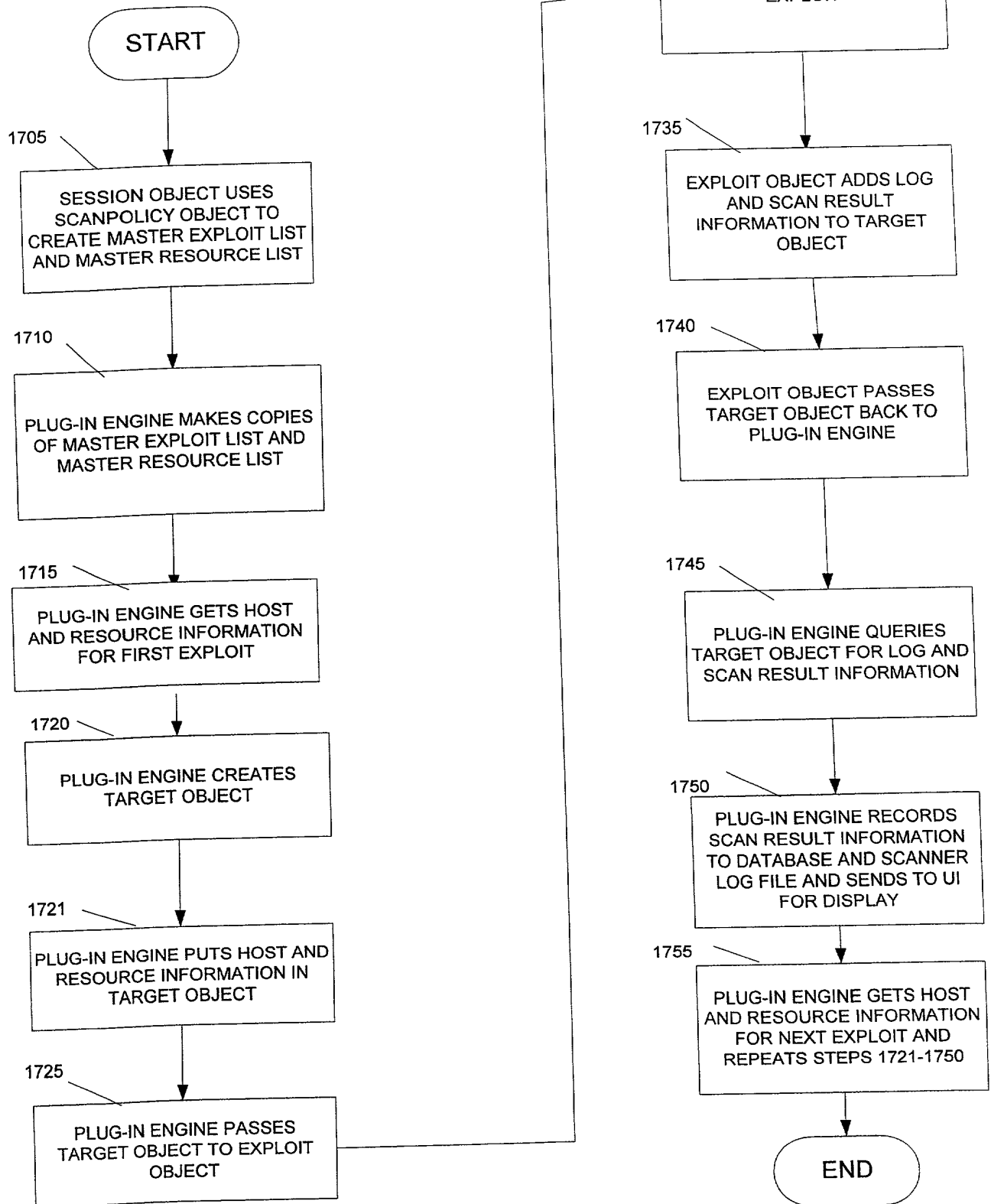
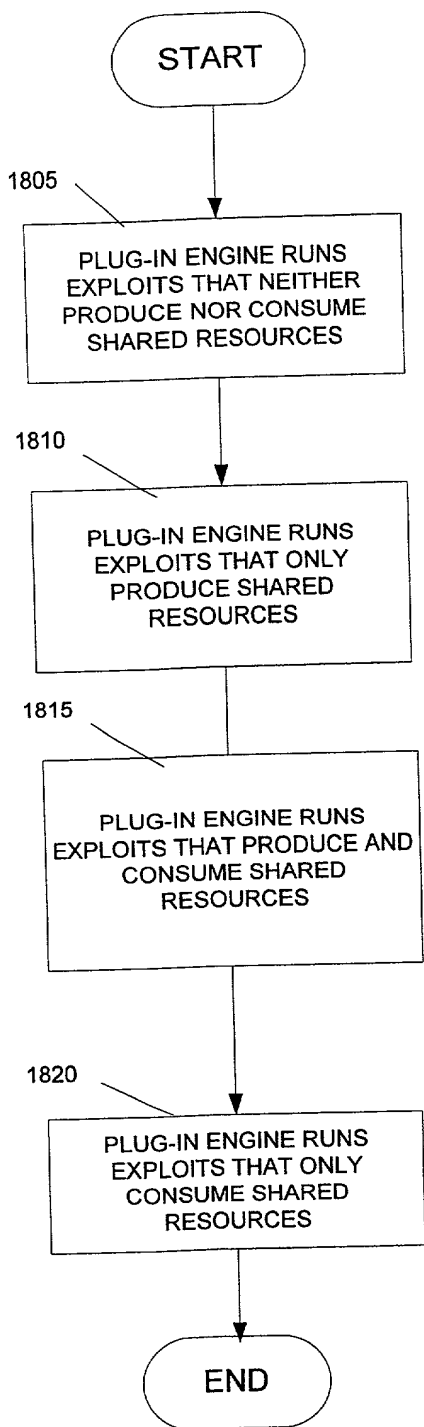


FIG. 18



**DECLARATION AND POWER OF ATTORNEY**Attorney's Docket No. **05456.105002**

In re Application of: **Timothy D. Dodd, Scott Mewett, Curtis E. Ide, Kevin A. Overcash, David A. Dennerline, Bobby J. Williams, Martin D. Sells**

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name. I believe I am a original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled: **Method and System for Identifying, Fixing, and Updating Security Vulnerabilities**, the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I do not know and do not believe that the same was ever known or used by others in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to the date of this application. I further state that the invention was not in public use or on sale in the United States of America more than one year prior to the date of this application. *I understand that I have a duty of candor and good faith toward the Patent and Trademark Office*, and I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 (a)-(d) of the foreign application(s) for patent or inventor's certificate listed below, and have also identified below any foreign application for patent or inventor's certificate disclosing subject matter in common with the above-identified specification and having a filing date before that of the application on which priority is claimed:

<u>Application No.</u>	<u>Country</u>	<u>Filing Date</u>	<u>Priority Claimed Under 35 USC §119</u>
None			Yes _____ No <u>X</u> _____

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

<u>None</u>	<u>(Application No.)</u>	<u>(Filing Date)</u>	<u>(Application No.)</u>	<u>(Filing Date)</u>

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter disclosed and claimed in the present application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

<u>Application Serial No.</u>	<u>Filing Date</u>	<u>Status: patented, pending, abandoned</u>
None		

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statement were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patents issuing thereon.

**POWER OF ATTORNEY:** The following are hereby appointed to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: Sherry M. Knowles-33,052; W. Scott Petty-35,645; Clark G. Sullivan-36,942; Steven P. Wigmore-40,447; Curtis L. Doster-41,714; Charles Vorndran-45,315; Lisa K. Norton-44,977.

Send correspondence to: **King & Spalding**  
191 Peachtree Street, N.E., 45<sup>th</sup> Floor  
Atlanta, Georgia 30303

Direct telephone calls at **(404) 572-4600**  
W. Scott Petty

Full name of first inventor: Timothy D. Dodd	Citizenship: U.S.
Inventor's signature	Date:
Residence and Post Office Address: 2126 Brownings Trace, Tucker, GA 30084-4628	

**DECLARATION AND POWER OF ATTORNEY**Attorney's Docket No. **05456.105002**

In re Application of: **Timothy D. Dodd, Scott Mewett, Curtis E. Ide, Kevin A. Overcash, David A. Dennerline, Bobby J. Williams, Martin D. Sells**

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name. I believe I am a original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled: **Method and System for Identifying, Fixing, and Updating Security Vulnerabilities**, the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I do not know and do not believe that the same was ever known or used by others in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to the date of this application. I further state that the invention was not in public use or on sale in the United States of America more than one year prior to the date of this application. *I understand that I have a duty of candor and good faith toward the Patent and Trademark Office*, and I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 (a)-(d) of the foreign application(s) for patent or inventor's certificate listed below, and have also identified below any foreign application for patent or inventor's certificate disclosing subject matter in common with the above-identified specification and having a filing date before that of the application on which priority is claimed:

<u>Application No.</u>	<u>Country</u>	<u>Filing Date</u>	<u>Priority Claimed Under 35 USC §119</u>
None			Yes _____ No <u>X</u> _____

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

<u>None</u>	<u>(Filing Date)</u>	<u>(Application No.)</u>	<u>(Filing Date)</u>
(Application No.)			

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter disclosed and claimed in the present application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

<u>Application Serial No.</u>	<u>Filing Date</u>	<u>Status: patented, pending, abandoned</u>
None		

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statement were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patents issuing thereon.

**POWER OF ATTORNEY:** The following are hereby appointed to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: Sherry M. Knowles-33,052; W. Scott Petty-35,645; Clark G. Sullivan-36,942; Steven P. Wigmore-40,447; Curtis L. Doster-41,714; Charles Vorndran-45,315; Lisa K. Norton-44,977.

Send correspondence to: **King & Spalding**  
191 Peachtree Street, N.E., 45<sup>th</sup> Floor  
Atlanta, Georgia 30303

Direct telephone calls at **(404) 572-4600**  
W. Scott Petty

Full name of first inventor: Scott Mewett	Citizenship: Australian
Inventor's signature	Date:
Res. and Post Office Address: 6600 Peachtree-Dunwoody Road NE, 300 Embassy Row, Atlanta, GA 30328	

**DECLARATION AND POWER OF ATTORNEY**Attorney's Docket No. **05456.105002**

In re Application of: **Timothy D. Dodd, Scott Mewett, Curtis E. Ide, Kevin A. Overcash, David A. Dennerline, Bobby J. Williams, Martin D. Sells**

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name. I believe I am a original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled: **Method and System for Identifying, Fixing, and Updating Security Vulnerabilities**, the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I do not know and do not believe that the same was ever known or used by others in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to the date of this application. I further state that the invention was not in public use or on sale in the United States of America more than one year prior to the date of this application. *I understand that I have a duty of candor and good faith toward the Patent and Trademark Office*, and I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 (a)-(d) of the foreign application(s) for patent or inventor's certificate listed below, and have also identified below any foreign application for patent or inventor's certificate disclosing subject matter in common with the above-identified specification and having a filing date before that of the application on which priority is claimed:

<u>Application No.</u>	<u>Country</u>	<u>Filing Date</u>	<u>Priority Claimed Under 35 USC §119</u>
None			Yes _____ No <u>X</u> _____

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

<u>None</u>	<u>(Application No.)</u>	<u>(Filing Date)</u>	<u>(Application No.)</u>	<u>(Filing Date)</u>

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter disclosed and claimed in the present application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

<u>Application Serial No.</u>	<u>Filing Date</u>	<u>Status: patented, pending, abandoned</u>
None		

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Atlanta, Georgia 30303

Direct telephone calls at **(404) 572-4600**  
W. Scott Petty

Full name of first inventor: Curtis E. Ide	Citizenship: U.S.
Inventor's signature	Date:
Residence and Post Office Address: 235 Nestor Court, Roswell, GA 30076	

**DECLARATION AND POWER OF ATTORNEY**Attorney's Docket No. **05456.105002**

In re Application of: **Timothy D. Dodd, Scott Mewett, Curtis E. Ide, Kevin A. Overcash, David A. Dennerline, Bobby J. Williams, Martin D. Sells**

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<u>Application No.</u>	<u>Country</u>	<u>Filing Date</u>	<u>Priority Claimed Under 35 USC §119</u>
None			Yes _____ No <u>X</u>

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

<u>None</u>	<u>(Application No.)</u>	<u>(Filing Date)</u>	<u>(Application No.)</u>	<u>(Filing Date)</u>

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Atlanta, Georgia 30303

Direct telephone calls at **(404) 572-4600**  
W. Scott Petty

Full name of first inventor: Kevin A. Overcash	Citizenship: U.S.
Inventor's signature	Date:
Residence and Post Office Address: 1245 McLynn Ave., Atlanta, GA 30306	

**DECLARATION AND POWER OF ATTORNEY**Attorney's Docket No. **05456.105002**

In re Application of: **Timothy D. Dodd, Scott Mewett, Curtis E. Ide, Kevin A. Overcash, David A. Dennerline, Bobby J. Williams, Martin D. Sells**

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<u>Application No.</u>	<u>Country</u>	<u>Filing Date</u>	<u>Priority Claimed Under 35 USC §119</u>
None			Yes _____ No <u>X</u>

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<u>None</u>	<u>(Application No.)</u>	<u>(Filing Date)</u>	<u>(Application No.)</u>	<u>(Filing Date)</u>

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Atlanta, Georgia 30303

Direct telephone calls at **(404) 572-4600**

W. Scott Petty

Full name of first inventor: David A. Dennerline	Citizenship: U.S.
Inventor's signature	Date:
Residence and Post Office Address: 1280 W. Peachtree St., Apt. 1808, Atlanta, GA 30010-1581	



**DECLARATION AND POWER OF ATTORNEY**Attorney's Docket No. **05456.105002**

In re Application of: **Timothy D. Dodd, Scott Mewett, Curtis E. Ide, Kevin A. Overcash, David A. Dennerline, Bobby J. Williams, Martin D. Sells**

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<u>Application No.</u>	<u>Country</u>	<u>Filing Date</u>	<u>Priority Claimed Under 35 USC §119</u>
None			Yes _____ No <u>X</u> _____

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<u>None</u>	<u>(Application No.)</u>	<u>(Filing Date)</u>	<u>(Application No.)</u>	<u>(Filing Date)</u>

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Atlanta, Georgia 30303

Direct telephone calls at **(404) 572-4600**

W. Scott Petty

Full name of first inventor: Bobby J. Williams	Citizenship: U.S.
Inventor's signature	Date:
Residence and Post Office Address: 1280 West Peachtree, Apt. 3407, Atlanta, GA 30309	

**DECLARATION AND POWER OF ATTORNEY**Attorney's Docket No. **05456.105002**

In re Application of: **Timothy D. Dodd, Scott Mewett, Curtis E. Ide, Kevin A. Overcash, David A. Dennerline, Bobby J. Williams, Martin D. Sells**

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<u>Application No.</u>	<u>Country</u>	<u>Filing Date</u>	<u>Priority Claimed Under 35 USC §119</u>
None			Yes _____ No <u>X</u> _____

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Atlanta, Georgia 30303

Direct telephone calls at **(404) 572-4600**

W. Scott Petty

Full name of first inventor: Martin D. Sells	Citizenship: Canadian
Inventor's signature	Date:
Residence and Post Office Address: 2753 Sugar Pike Road, Canton, GA 30115	